REMARKS

Claims 1, 2, 4, 13, 14, 21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lester, U.S. Patent 6,091,085 in view of Scherer et al., U.S. Patent 6,534,798 (hereinafter "Scherer"). Applicants respectfully traverse the rejection.

The Examiner states on pages 6 and 7 of the office action:

> The '085 reference discloses in Fig. 7 and respective portion of the specification a light emitting device substantially as described. . . .
>
> Specifically, the reference discloses a light emitting device comprising: . . . a photonic crystal structure (generally indicated at hole pattern 35, Fig. 7, col. 5, lines 30-45) formed in at least a portion of the p-type region. . . .
>
> As for the limitation 'a metal reflector disposed on at least a portion of a surface of the p-type region opposite the active region,' Scherer, in also disclosing a light emitting device, teaches that a light emitting device having a metal reflector (such as a metal reflector 18, Fig. 1H, col. 5, lines 10-20) disposed on at least a portion of a surface of the p-type region or the n-type region . . . helps with light output ('quantum efficiencies') of the light emitting device (column 1, lines 20-30). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the '085 reference's light emitting device such that it includes a metal reflector such as the silver reflector 18, taught by Scherer . . . . One would have been motivated to make such a change in view of the teachings in Scherer that such a change results in higher light output for the light emitting device.

The Examiner cites hole pattern 35 of Fig. 7 of Lester (the '085 patent) as being a photonic crystal. Lester describes this structure, referred to as light pipes, at column 5 lines 19-21: "The third method for disrupting the waveguide is to insert vertical light pipes into the waveguide. Light entering these light pipes is piped to the surface where it escapes." Emphasis added. Thus, in Lester's device, holes 35 are designed to direct light out the top surface of the device.

The Examiner proposes placing Scherer's metal reflector on a surface of Lester's semiconductor structure. The only possible major surface of Lester's semiconductor structure available for such a reflector is the top surface, since the bottom surface cannot be accessed due to substrate 33.

PATENT LAW GROUP LLP
2635 N. FIRST ST.
SUITE 223
SAN JOSE, CA 95134
(408) 382-0480
FAX (408) 382-0481

A person of skill in the art would never be motivated to form both Lester's light pipes and a reflector on the top surface of a semiconductor device, since the light pipes and the reflector serve opposite purposes: the light pipes extract light through the top surface, while the reflector prevents light from escaping through the top surface. As these effects cancel each other out, a person of skill in the art would not expect such a device to have high light output, as promised by the Examiner.

Since there is no motivation to combine Lester with Scherer as proposed by the Examiner, claim 1 is allowable over the combination of Lester and Scherer. Claims 2, 4, 13, 14, 21 and 26 depend from claim 1 and are thus allowable over Lester and Scherer for at least the same reasons as claim 1.

Claims 1-28, 32, and 33 are rejected under 35 U.S.C. 102(b) an anticipated by, or in the alternative, under 35 U.S.C. 103(a) as obvious over Scherer in view of Lester. Applicants respectfully traverse the rejection.

Regarding the anticipation rejection, the Examiner states on pages 8 and 9 of the office action:

> The '798 reference appears to disclose in the Background Art Section and respective portions of the specification a light emitting device as claimed. Specifically, the '798 reference disclose in the Background Art Section that 'to build an ideal, highly efficient light-emitting diode (LED), it is desirable to improve the extraction efficiency and simultaneously enhance the spontaneous emission rate. A 15-fold emission intensity enhancement, with Purcell factor Fp=2 was observed in two dimensional periodic thin film photonic crystals' (col. 1, lines 40-50, emphasis added). The '798 reference then proposed an improvement over the prior art by forming a periodic pattern in a top metal layer overlying a III-nitride light emitting layer (Abstract, columns 1-5, particularly Abstract and col. 1, lines 45-50). [Emphasis in original.]
>
> In other words, it appears that the prior art's light emitting device as disclosed by the '798 reference already comprises photonic crystals in one or more of the doped III-nitride semiconductor layers that form the basic [sic] of a light emitting device, because the '798 reference proposes forming a periodic pattern in the top metal layer only; and as such the prior art's light emitting device as disclosed by the '798 reference meets the requirement of at least independent claim 1.

PATENT LAW GROUP LLP
2635 N. FIRST ST.
SUITE 223
SAN JOSE, CA 95134
(408) 382-0480
FAX (408) 382-0481

Applicants respectfully submit that in the sections of Scherer referenced by the Examiner, Scherer teaches forming a periodic pattern in a metal layer. Applicants have found no teaching in those sections of a photonic crystal formed in a semiconductor layer. In the passage quoted and underlined above referring to "thin film photonic crystals," Scherer does not specify in what material the photonic crystals are formed. Accordingly, Scherer does not teach "a photonic crystal structure formed in at least a portion of the n-type region" and therefore does not anticipate claim 1. Claims 2-28, 32, and 33 depend from claim 1 and are therefore also not anticipated by Scherer for at least the same reasons as claim 1.

Regarding the obviousness rejection, the Examiner states on pages 9 and 10 of the office action:

> In the alternative, the '798 reference proposes forming a photonic crystal structure ('periodic pattern') in the top metal layer overlying a III-nitride light emitting layer (which is termed a 'semiconductor core,' Figs. 1 and 3), as detailed above. . . .
>
> However, as noted above, the reference does not disclose forming the photonic crystal structure in a portion of the doped III-nitride light emitting layer.
>
> Lester in the '085 reference, in also disclosing a light emitting device including a III-nitride layer and a photonic structure as described above in paragraph numbered 5, teaches that the photonic structure, which is a hole pattern, should extend down into a portion of the doped III-nitride light emitting layer so as to increase light intensity.

As noted above, Lester's light pipes direct light to the surface of the device, where the light escapes. Scherer relies on a completely different mechanism, "coupling to surface plasmons." See Scherer, column 4, lines 26-27. The Examiner has not pointed to any teaching in either reference that combining the two mechanisms would produce a desirable result.

PATENT LAW GROUP LLP
2635 N. FIRST ST.
SUITE 223
SAN JOSE, CA 95134
(408) 382-0480
FAX (408) 382-0481

In fact, Scherer teaches away from combination with Lester at column 4, line 36, which states "[t]he increased light emission is due to an increase in the efficiency and an increase in the pumping intensity resulting from trapping of pump photons within the

microcavity." Emphasis added. This passage teaches that it is preferred to trap photons within the microcavity, not extract them as with Lester's light pipes. The passage suggests that including a structure like Lester's that directs light to the surface of the device would actually result in WORSE performance, rather than better as suggested by the Examiner.

Since Scherer teaches away from combination with Lester, claim 1 is allowable over Scherer and Lester. Claims 2-28, 32, and 33 depend from claim 1 and are therefore allowable over Scherer and Lester for at least the same reasons as claim 1.

Claims 1, 2, 4, 8, 13, 14, 17-21, 26, and 27 are rejected under 35 U.S.C. 102(e) as being anticipated by Erchak et al., US 6,831,302 (hereinafter "Erchak"). Claims 3, 5-7, 9-12, 15, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Erchak. Applicants intend to submit an appropriate declaration to establish invention of the subject matter of any rejected claim prior to the effective date of Erchak, once the other prior art rejections made by the Examiner are overcome.

In view of the above arguments, Applicants respectfully request allowance of all pending claims. Should the Examiner have any questions, the Examiner is invited to call the undersigned at (408) 382-0480.

Respectfully submitted,

/Rachel V. Leiterman/

Rachel V. Leiterman
Attorney for Applicants
Reg. No. 46,868

PATENT LAW
GROUP LLP
2635 N. FIRST ST.
SUITE 223
SAN JOSE, CA 95134
(408) 382-0480
FAX (408) 382-0481